

RA 1792

Programmable synthesized receiver

Frequency range 100 kHz to 30 MHz

Frequency entry keypad and single-knob flywheel tuning

100 programmable channels in non-volatile memory

Automatic scanning of 10 channels

Local, extended or remote control versions

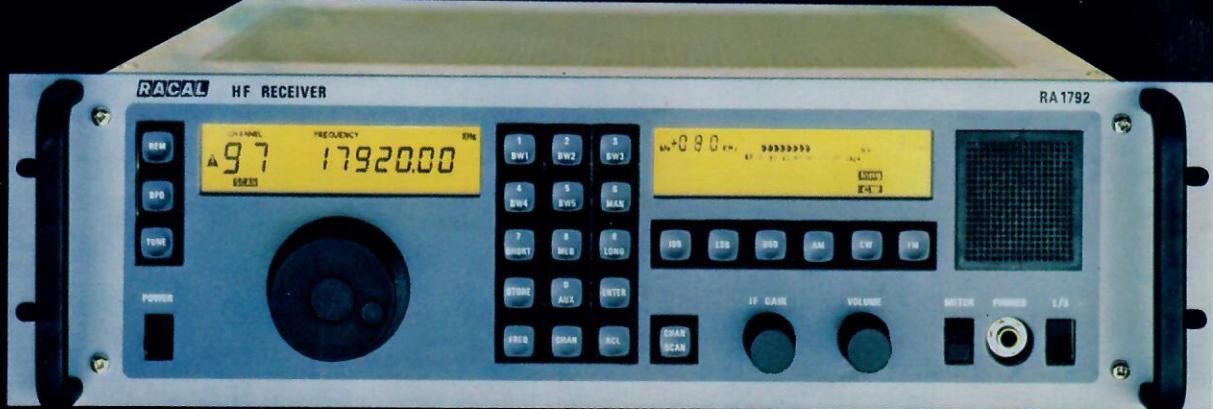
High performance — cost-effective design

Surveillance, channel-scanning and general-purpose applications

Use by defence forces and civil authorities

Built-in self test facilities

Racal Communications Limited



Programmable Synthesized Receiver RA 1792

The RACAL RA 1792 is a high-performance, cost-effective, programmable synthesized receiver, covering the frequency range 100 kHz to 30 MHz in 10 Hz steps.

Using the most advanced receiver design techniques, and microprocessor control, it incorporates many novel features, and further enhances the company's already high international reputation for the technical leadership, performance, quality and reliability of its professional communications equipment.

The receiver fulfills a wide variety of roles in both defence and civil communications, and is suitable for either fixed or transportable station use. Of particular value in surveillance and channel-scanning applications, its cost-effective performance and versatility also make it the ideal general-purpose receiver.

Rapid and precise frequency setting, in 10 Hz increments over the whole frequency range, is achieved by use of either a keypad or a single, variable-rate, flywheel tuning control.

Reception of USB, LSB, AM, MCW, CW and FM modes is provided as standard, with ISB available as an option. FSK reception may be achieved by using an external modem.

Two of the outstanding features of the receiver are its ability to store, for instant recall, frequency and mode data on up to 100 channels, and the facility to scan up to 10 of these pre-programmed channels automatically.

Two liquid crystal displays on the front panel indicate channel number, frequency, receiver operating conditions and mode, and include indications of audio line or RF signal level.

The receiver may be controlled either locally or externally, essential in many radio surveillance applications. Comprehensive external control can be effected by using the

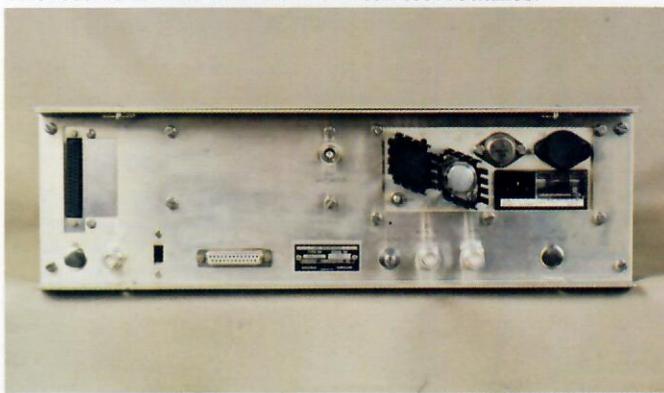
MA1075 Remote Control Unit, or in radio surveillance systems by using the MA1113 Operator Control Unit. Control over an IEEE 488 data bus is also available.

Control of the programmable channels can be accomplished using the Racal LA1519/1520 sequential tone system.

A self-contained power unit permits operation from 100-125 V/200-250 V AC, or 18-32 V DC. (Optional replacement unit).

The RA 1792 is compact and robustly constructed, and may be supplied as a standard rack-mounting unit or housed in one of two types of bench-mounting cabinet: a commercial type, or a specially constructed unit for transportable use.

The receiver also contains built-in self test routines.



Rear panel of RA 1792 showing connectors and components.

RA 1792 Receiver Block Diagram

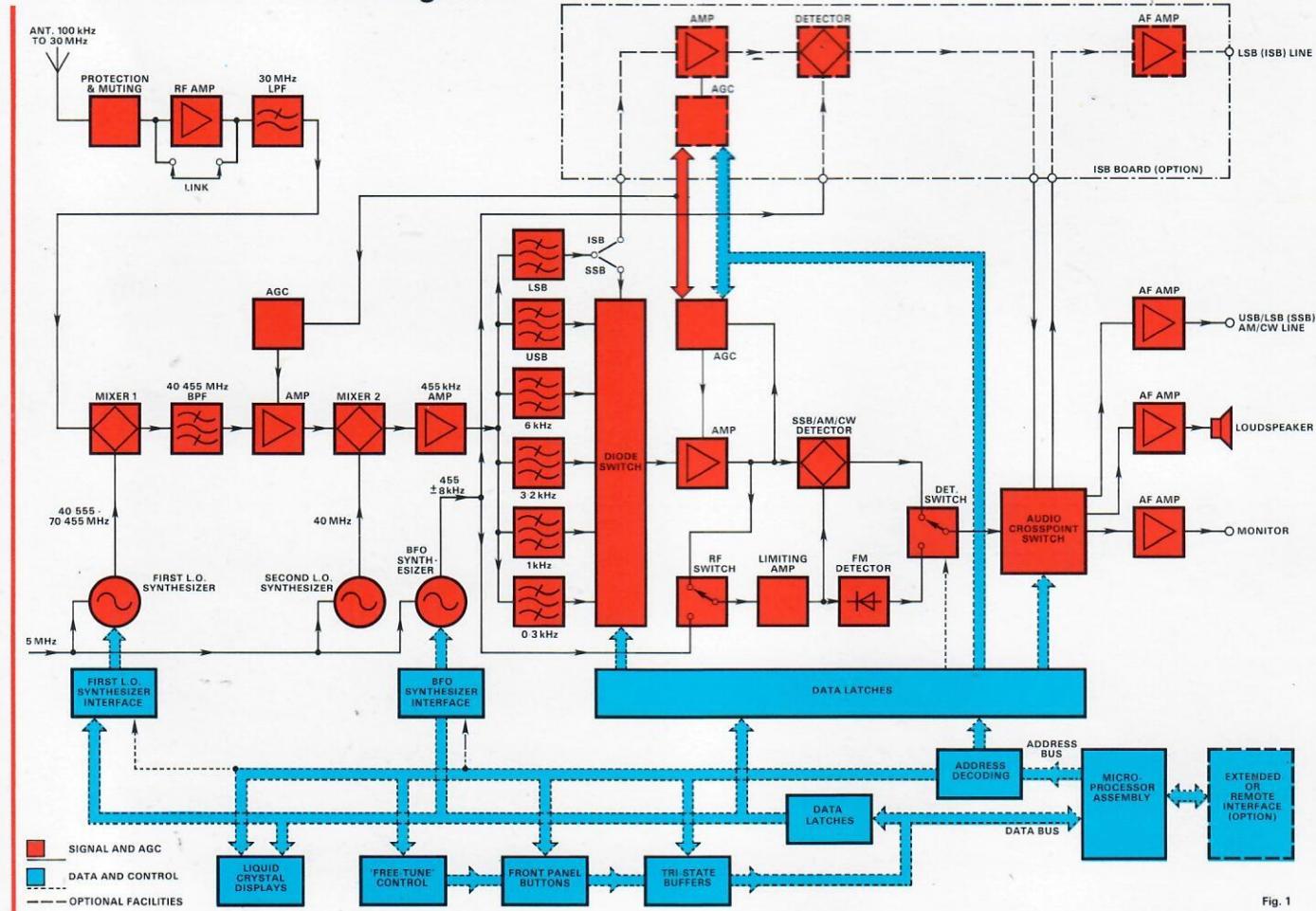


Fig. 1

General Description

The design of the RA 1792 receiver combines superb signal-handling characteristics with the latest microprocessor control techniques to provide outstanding performance and unrivalled versatility. Particular attention has been paid to dynamic range, intermodulation products, reciprocal mixing, cross modulation, blocking and spurious responses.

The controls are simple to operate, yet offer comprehensive facilities with maximum flexibility of use. The microprocessor permits storage and instant recall of up to 100 channel frequencies and modes, and provides the automatic channel scanning facility.

The receiver controls and displays may be used to tune the receiver, or to interrogate or modify the channel stores.

For maximum operator convenience, the frequency may be set either by the keypad or by the single-knob flywheel tuning control. This tuning control is enabled by the TUNE button and its tuning rate is automatically varied with its speed of rotation; the slowest rate permitting tuning in 10 Hz steps. It also has two other functions: in the 'Channel' mode, it selects channels in numerical sequence at a rate of 10 channels per turn; and in the CW mode, with the BFO button selected, it varies the BFO note at 1 kHz per turn.

Use of the 'Frequency' or 'Channel' buttons disables the free-tune facility and permits use of the frequency entry pad. With these controls, a new frequency or channel is selected using the push-buttons and entered into the receiver by pushing the ENTER button. If the channel/frequency information is not entered, use of the 'Recall' button enables the receiver display to be reset to the original operating conditions.

The built-in EAROM memory unit may be programmed with up to 100 channel frequencies and modes and ensures that this stored information is retained for several years if the receiver is disconnected from the mains supply or removed from service. This facility provides rapid access to selected frequencies in regular use. Any of the 100 channels can be re-programmed at any time without specialized test gear or training.

Information is stored in the receiver memory by selecting the 'Channel' mode, pressing and holding the STORE button and entering two digits for the channel number. Information on any frequency and mode previously set up on the display is stored in that channel when the button is released. The display then

reverts to the actual operating frequency and mode. During the store operation, normal reception is not interrupted.

Automatic scanning of up to ten channels in any decade of the 100 stored channels (00-09, 10-19, etc.) is initiated by selecting the number of that decade (0, 1, etc.) and pressing the CHAN SCAN button. The dwell time on each channel is variable from 0.1 to 10 seconds, in ten steps, pre-selected by pressing 0 to 9 on the numeric keypad. Whether any channel is to be scanned or not is pre-programmed using the front panel push-buttons.

Modes are push-button selected, the chosen mode being indicated on the right hand display. A maximum of six IF bandwidths can be accommodated including the asymmetrical USB and LSB filters which are selected automatically when the appropriate mode push-buttons are used. The symmetrical bandwidths are selected on the numeric keypad which also controls AGC operation. A choice of three time constants is available for normal AGC operation and for AGC with the threshold set by the IF GAIN control. Manual gain control is also provided.

An internal switch permits bandwidth, AGC, and BFO offset to be pre-set for each mode, so that they are automatically recalled when the mode is selected, although the operator can subsequently change them if desired.

Any mode, bandwidth, AGC time constant and BFO offset may be pre-programmed for selection by the AUX push-button. A typical application for this facility would be FSK reception (in conjunction with an external demodulator).

The 'Remote' push button is pressed to change the receiver operation from local to remote control or vice versa. When being controlled from a remote location this fact is signalled by the presence of the REMOTE indicator in the left-hand display. Incoming frequency and mode settings are then shown.

Racal manufacture both manual (MA 1120) and automatic (MA 1101) frequency following pre-selector units for use in applications where the RA 1792 is co-sited with a transmitter.

Comprehensive input and output connectors on the rear panel of the receiver provide access to the various facilities and options so that the RA 1792 may be used in complex receiving systems.

A switched monitor loudspeaker and front panel headphone jack are provided, in addition to comprehensive monitoring facilities.

Principle of Operation

The block diagram (Fig. 1) shows the principle of operation of the RA 1792 Receiver.

The input signal, in the range 100 kHz to 30 MHz, is fed via an RF amplifier stage and a 30 MHz low-pass filter to the first mixer. The amplifier stage may be linked out of circuit if necessary.

In the first mixer the received signal is combined with the output of the first local oscillator, a synthesizer covering the frequency range 40.555 MHz to 70.455 MHz in 10 Hz steps. This produces a first IF of 40.455 MHz which is fed via a crystal roofing filter of 16 kHz bandwidth and an AGC controlled amplifier to the second mixer. This roofing filter provides an additional selectivity option in the AM mode.

The 40.455 MHz first IF is combined with the fixed 40 MHz output from the second oscillator synthesizer to produce a 455 kHz second IF. After amplification, this second IF is routed to a bank of six 455 kHz filters which provide the main receiver selectivity. These are selected by diode switches, and can be linked to mode.

A further AGC-controlled amplifier follows before demodulation takes place. In the SSB/CW/AM modes a product/synchronous detector is used. The BFO synthesizer generates a fixed 455 kHz reinserted/synchronous carrier for SSB/AM detection, but in the CW mode this signal is either variable ± 8 kHz in 10 Hz steps or may be pre-programmed to provide a fixed offset BFO note, e.g. 800 Hz or 1.5 kHz. For FM reception the 455 kHz second IF is routed via a limiting amplifier to a separate FM detector.

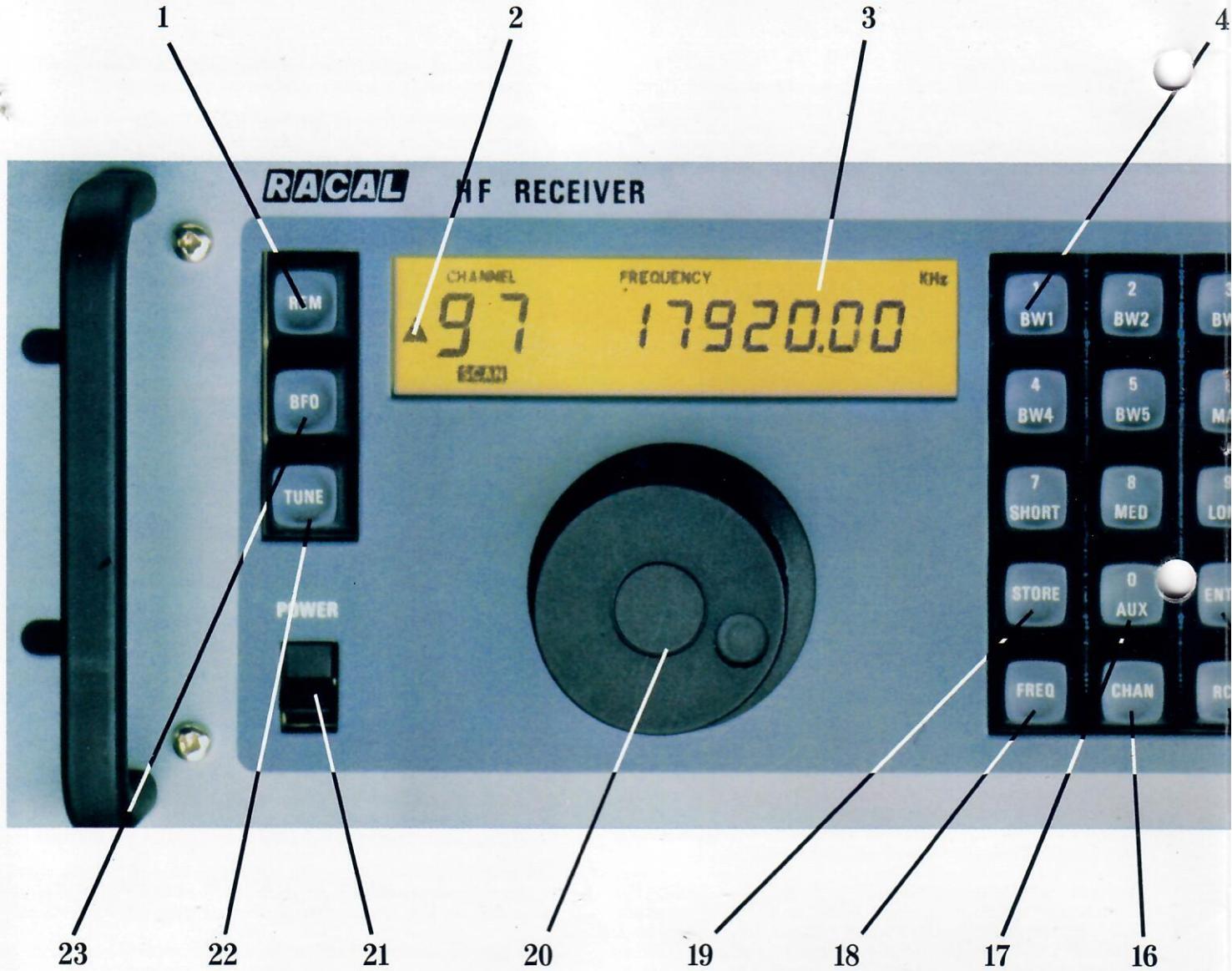
All three outputs from the synthesizers are referenced to a 5 MHz inbuilt standard frequency source. Alternatively, an external standard may be used.

The demodulated signal is then fed through the audio crosspoint switch to separate AF amplifiers which provide outputs for (a) a 600 ohm line (b) an internal loudspeaker and a headphone jack and (c) an external loudspeaker.

For ISB operation the optional ISB board provides the LSB signal path, while the receiver proper provides that for the USB. The LSB component of the 455 kHz second IF is processed through similar circuitry to that for the USB, with the common BFO synthesizer providing the reinserted carrier for demodulation. A separate audio amplifier provides a 600 ohm line output.

All command signals, whether from the front panel controls or from an extended or remote operating position, are processed by the microprocessor assembly which incorporates non-volatile EAROMs. These store pre-programmed frequency and mode information in each of 100 discrete channel locations for instant recall. Two separate buses carry control data and address information to/from the microprocessor, via data latches to the synthesizer interfaces for frequency selection, and to the appropriate switching circuits determining choice of mode.

Self test routines are initiated by means of a switch mounted inside the front panel, and individual tests can be started/stopped by use of the "REM" button. Test numbers and conditions are displayed on the liquid crystal displays.



1. Remote Push-button

Switches to extended or remote control condition, or returns receiver to local operation.

2.

Indicates when the contents of the displays do not match the operating conditions of the receiver.

3. Liquid Crystal Display (Left-hand)

Indicates channel number, frequency, and receiver operating conditions.

4. Numeric Keypad

Selects frequency, channel number, bandwidth, AGC conditions, dwell time on 'Scan', and 'Auxiliary' mode.

5. Liquid Crystal Display (Right-hand)

Indicates mode, AGC conditions, BFO offset, bandwidth, audio line or RF level, and fault (e.g. synthesizer out of lock).

6. Mode Push-buttons

Select required operating mode.

7. Loudspeaker

8. Loudspeaker Switch
Switches loudspeaker on/off.

9. Headphone Jack

Insertion of jackplug mutes loudspeaker.

10. Meter Switch

Selects AF line or RF level monitoring.

11. Volume Control

Controls AF level to loudspeaker or headphones.

12. IF Gain Control

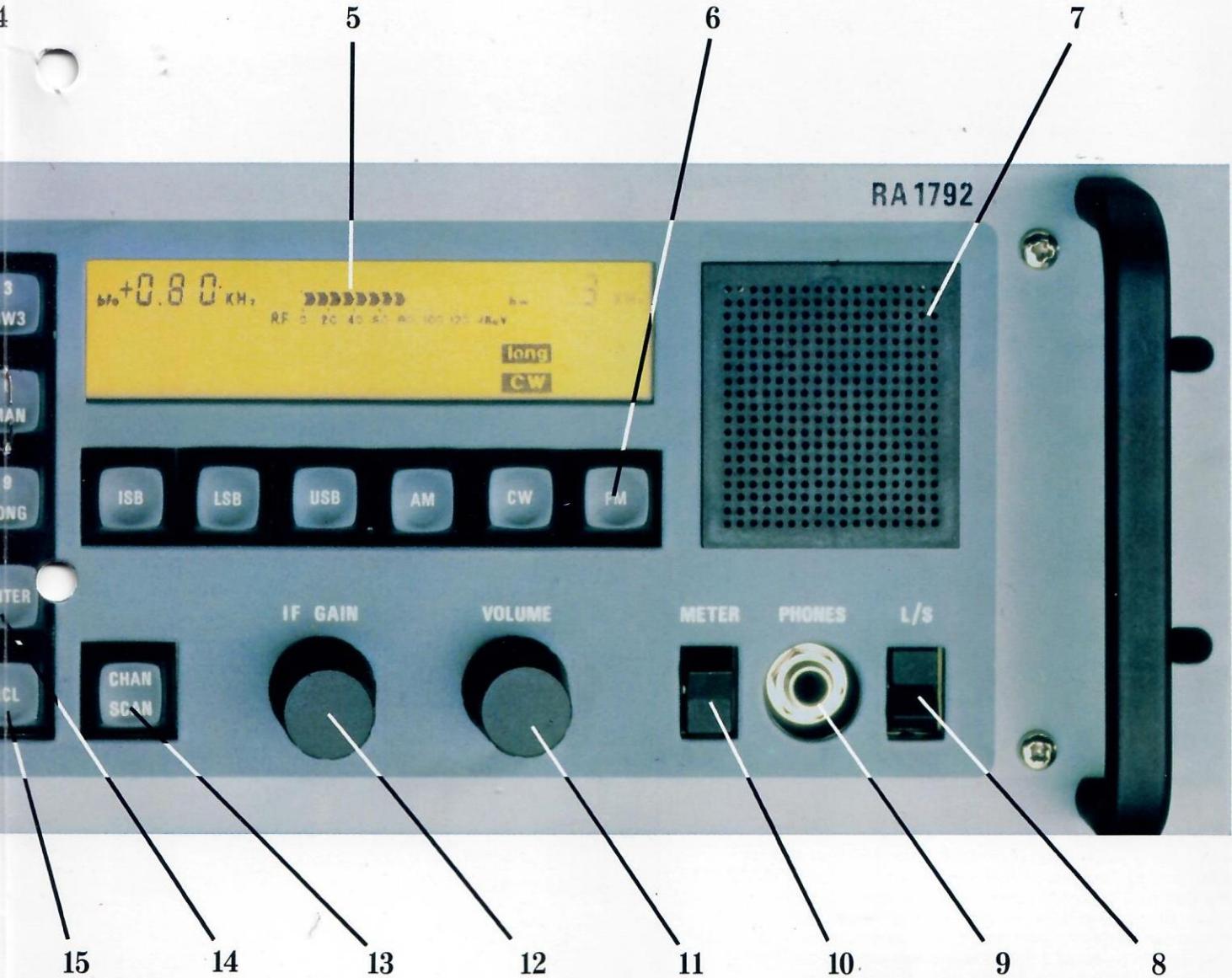
In the 'Manual' gain control condition, controls the receiver gain. If selection of 'Manual' is followed by selection of an AGC time constant, sets the AGC threshold.

13. Chan Scan Push-button

In 'Channel' mode, selects or cancels the 'Scan' function on that channel.

In 'Recall' mode, initiates or stops the scanning sequence.

RA1792 Receiver-Front Pa



14. Enter Push-button

Switches receiver to new operating channel or frequency, whichever has been previously selected.

15. Recall Push-button

Resets displays to receiver operating conditions after 'Frequency' or 'Channel' push-buttons have been pressed.

16. Channel Push-button

Switches to 'Channel' mode, permitting channel number to be selected using numeric keypad or 'Tune' control. This enables channel contents to be interrogated or the new channel to be selected (See 14.).

17. Auxiliary Push-button

Selects 'Auxiliary' mode, which may be pre-set for any mode of reception, bandwidth, AGC time constant, and BFO offset.

18. Frequency Push-button

Permits frequency entry using the numeric keypad, starting with the left-hand (10 MHz) digit. A marker is displayed to indicate next digit to be entered.

19. Store Push-button

By pressing and holding this button, followed by selecting two digits for channel number, any frequency and mode previously set up on the displays are stored in that channel.

20. Tune Control

Enabled by the 'Tune' button, provides variable-rate flywheel tuning in 10 Hz steps. Also, in 'Channel' mode, selects channels in numerical sequence; in CW mode, with BFO button pressed, varies BFO note.

21. Power Switch

Switches power supply on/off.

22. Tune Push-button

Permits free tuning of the receiver using the 'Tune' control.

23. BFO Push-button

In the CW mode, enables 'Tune' control to vary BFO note.

Panel Controls and Displays

Extended/Remote Control

The simplified block diagrams show the interconnections between the RA 1792 Receiver and the units providing extended or remote control facilities.

Extended Control

For extended operation (Fig. 2), the LA 1519 Extended Control Unit provides:

- (a) selection of any one of up to 100 pre-programmed channels;
- (b) fine tune in 10Hz increments.

Eleven wires are used to carry the control signals from the LA 1519 to the receiver: eight BCD-coded for channel selection, two for up/down tune, and one for the clock signal.

Remote Control

Two systems of remote control are available: the LA 1519/1520 sequential tone system, and the MA 1075 Remote Control Unit used on a 1:1 basis.

Fig. 3 shows the sequential tone system which provides:

- (a) selection of any one of up to 100 pre-programmed channels;
- (b) fine tune in 10Hz increments.

The LA 1519 Remote Control Unit transmits the control signals in serial form to the LA 1520 Slave Unit over two wires of a four-wire telephone line, the other two wires being used for one audio output from the receiver. The LA 1520 converts the control signals into parallel form for connection via an eleven-wire cable to the Extended Control Board in the receiver. The function of these eleven wires is the same as described earlier for Extended Control.

An additional pair is required for the LSB audio signal for ISB operation.

Fig. 4 shows a typical remotely controlled receiver installation. Full control of all the receiver functions is provided by the MA 1075 Remote Control Unit which carries the same controls and displays as on the receiver front panel. Control data is transmitted over unconditioned telephone lines, using standard data modems, to the RA 1792. Revertive check information is transmitted back to the Control Unit to indicate the receiver operating conditions.

Extended Control of RA 1792 Receiver (including ISB option)

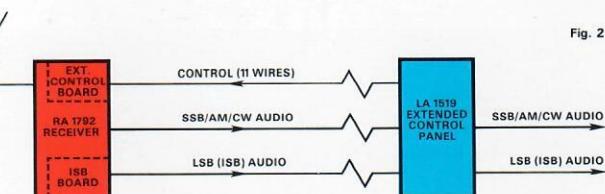


Fig. 2

Remote Control of RA 1792 Receiver using LA 1519/1520 Sequential Tone System (including ISB option)

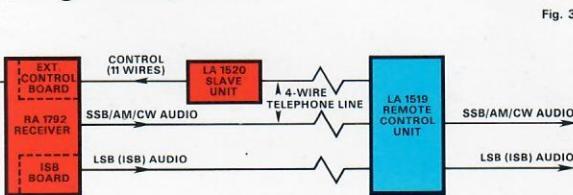


Fig. 3

Remote Control Installation using MA 1075

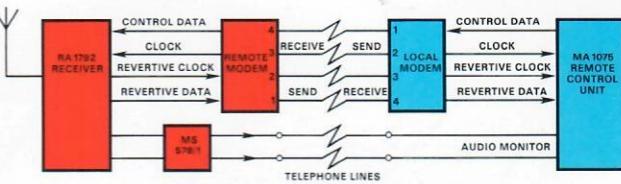
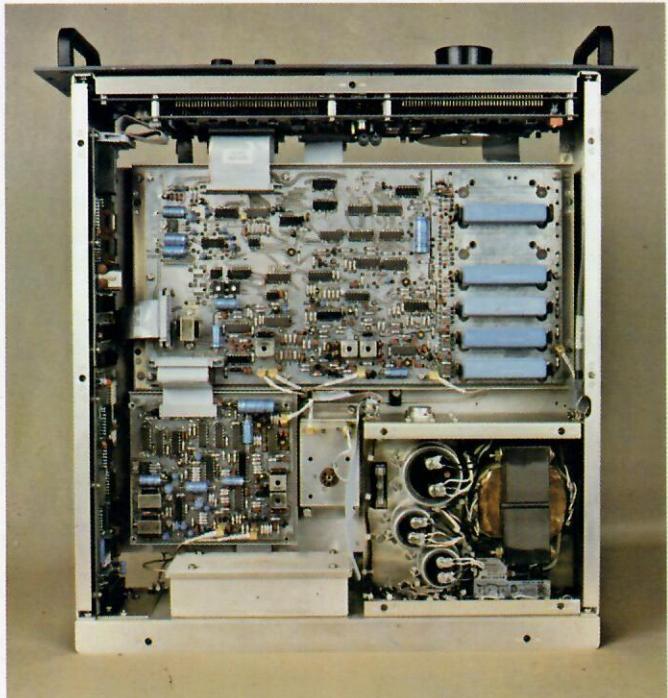
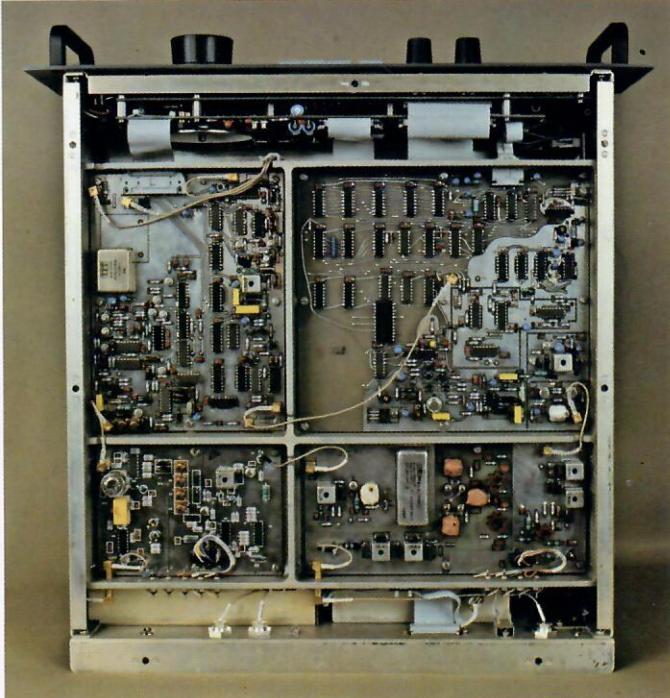


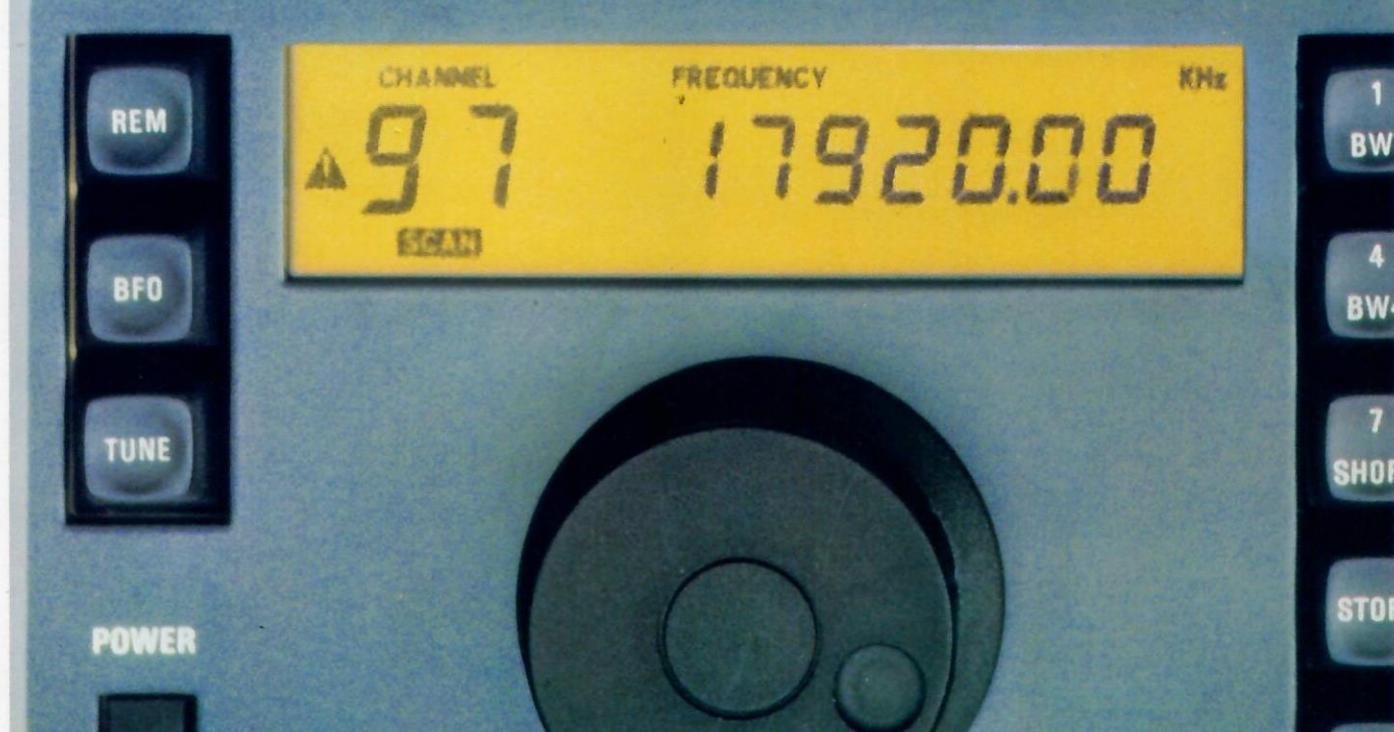
Fig. 4



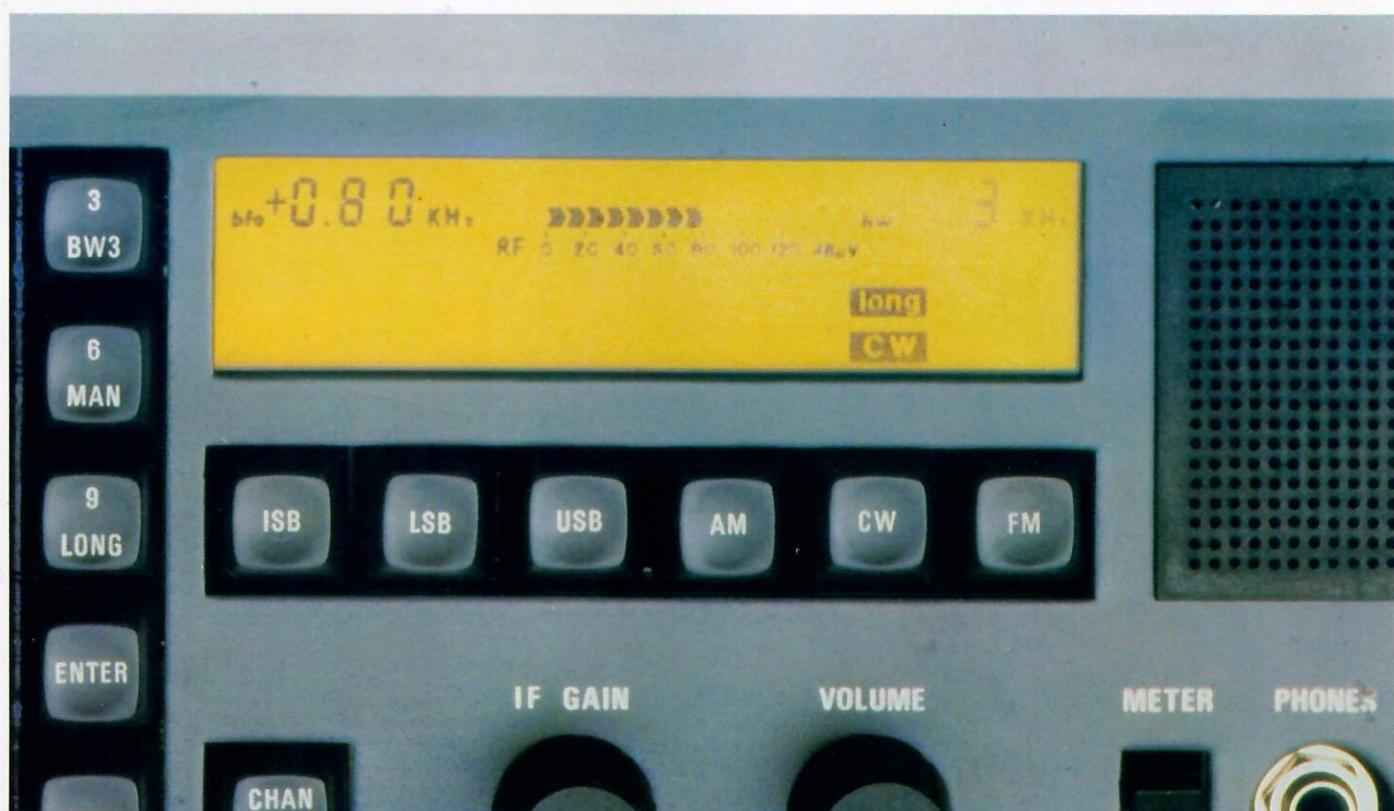
Interior view of RA 1792 showing accessibility for maintenance (topside).



Interior view of RA 1792 showing accessibility for maintenance (underside).

RACAL**HF RECEIVER**

Liquid crystal display (left-hand) indicating channel number, frequency, and receiver operating conditions.



Liquid crystal display (right-hand) indicating mode, AGC conditions, BFO offset, bandwidth, audio line or RF level, and fault conditions.

Frequency range
100kHz to 30MHz.

Modes of reception
USB/LSB (A3A, A3H, A3J, A2A, A2H, A2J).
AM (A3)
MCW (A2)
CW (A1)
ISB (A3B) optional.
FM (F3)

Auxiliary—provides demodulation signal centred on optional fixed BFO offset frequency.

Tuning

Continuously tunable synthesizer in 10Hz steps over the whole frequency range. Frequency setting either by numerical keypad or by single flywheel tuning knob with continuously variable tuning rate from 100Hz per turn to approximately 20kHz per turn, dependent upon speed of rotation. Tuning in 1Hz steps is available as an option when the receiver is to be used for frequency measurement applications.

Pre-programmed channels

EAROM memory unit may be programmed with up to 100 channel frequencies and modes which may be recalled by keypad or 'Tune' control.

Channel scanning

Automatic scanning of up to ten channels in any decade of the 100 stored channels. Dwell time on each channel variable in ten steps from 0.1 to 10 seconds, pre-selected by numeric keypad.

Frequency stability

Dependent upon frequency standard used:
1. The following optional internal standards may be fitted:

- (a) Temperature Compensated Crystal Oscillator (TCXO):
± 1.5 in 10⁶ from -10°C to +55°C
- (b) Type 9442:
 - (i) Temperature: ± 3 in 10⁶/°C.
 - (ii) Long term: ± 3 in 10⁹ per day after 3 months continuous operation.

2. External standard input: 1MHz or 5MHz, level 0dBm into 50 ohms.

Antenna input

- (a) Wideband, 50 ohms to 75 ohms nominal.
- (b) The receiver will withstand without damage input signals of 50V EMF continuously. A fuse and spark gap are provided for protection against higher voltages.
- (c) Re-radiation:
 - (i) 0 to 30MHz: not greater than 10μV PD.
 - (ii) 30 to 100MHz: not greater than 200pW.

Sensitivity

100-500kHz

SSB and CW 3μV (-103dBm) for 10dB signal plus noise to noise ratio in 3kHz bandwidth.

AM 10μV (-93dBm) input 70% modulation at 1kHz for 10dB signal plus noise to noise ratio.

500kHz-30MHz

SSB and CW 1μV (-113dBm) for 10dB signal plus noise to noise ratio in 3kHz bandwidth.

AM 3μV (-103dBm) input 70% modulation at 1kHz for 10dB signal plus noise to noise ratio.

Note:

Optional connection of built-in RF amplifier gives a sensitivity of 15dB for voltage levels quoted.

IF Selectivity

- (a) SSB/ISB (A3A, A3J, A3B):
 - Passband at -6dB: 250Hz to 3200Hz.
 - Passband at -60dB: -400Hz to 4300Hz.
- (b) CW/MCW/AM/FM (A1, A2, A3, A2H, A3H, F3):
 - Four filters provide the following nominal bandwidths as standard:
 - 300Hz
 - 1kHz
 - 3.2kHz
 - 6kHz

Note: A maximum of six filters may be fitted. In addition there is a 'filter bypass' position which gives a nominal 16kHz bandwidth.

Cross modulation

With a wanted signal of 1mV EMF in a 3kHz bandwidth, an unwanted signal 30% modulated removed not less than 20kHz, must be greater than 500mV EMF to produce an output 20dB below the output produced by the wanted signal.

Reciprocal mixing

With a wanted signal of less than 100μV EMF in a 3kHz bandwidth, an unwanted signal more than 20kHz removed will be typically greater than 70dB above the wanted signal level to give a noise level 20dB below the output produced by the wanted signal.

Blocking

With a wanted signal of 1mV EMF, an unwanted signal more than 20kHz removed, must be greater than 1V EMF to reduce the output by 3dB.

Intermodulation products

- (a) In band:
 - Two 100mV EMF signals within the IF passband will produce third order intermodulation products not greater than -50dB at the IF output.
- (b) Out of band:
 - With two 30mV EMF signals, separated and removed from the wanted signal by not less than 25kHz, the third order intermodulation products will be typically better than 90dB below either of the interfering signals.

Spurious responses

- (a) External (including image and IF rejection):
 - External signals, removed more than 20kHz from the wanted frequency, must be greater than +80dB relative to 1μV EMF to produce an output equal to that produced by a 1μV EMF signal at the wanted frequency.
- (b) Internal:
 - The presence of an internally generated spurious response will not degrade the specified receiver sensitivity by more than 3dB.

AGC

- (a) Range:
 - An increase in input of 110dB above 2μV EMF will produce an output change of less than 2dB.
- (b) Time constants:
 - Short, medium and long—pre-set to be automatically selected by mode switching, but can be set independently by push-buttons. AGC lines are available at rear of receiver to permit diversity operation.

IF Gain Control

Control range 110dB.

Gain control may be switched either to manually set (a) receiver gain or (b) AGC threshold.

BFO

- (a) Variable by main 'Tune' control, ± 8kHz, synthesized in 10Hz steps.
- (b) Pre-selected fixed offsets, e.g., 1.2kHz, 1.5kHz, etc., may be stored for use with external demodulator.

Pre-set operating conditions

Bandwidth, AGC time constant, and BFO offset may be pre-set for each mode so that they are automatically recalled when the mode is selected.

'Auxiliary' mode may be set up for any mode, bandwidth, AGC time constant and BFO offset.

In the ISB mode, different AGC time constants may be stored for the two sidebands.

IF Output

455kHz, nominally 100mV into 50 ohms. (453.3kHz when 3.2kHz bandwidth selected (GA version only). A 100kHz IF output is also available as an option.

Muting

60dB minimum by earthing rear panel connection.

AF Output

- (a) Line output, 10mW nominal into 600 ohms balanced, adjustable by internal pre-set level control.
- (b) Phone output, 1mW maximum into 600 ohms unbalanced.
- (c) 200mW maximum to internal loudspeaker which may be switched in or out of operation.
- (d) Connection for external loudspeaker, 200mW into 16 ohms; 400mW into 8 ohms.

Metering

Front panel display switched to indicate:

- (a) RF level,
- (b) AF level to line.

Power supply

- (a) Nominal mains taps at 110, 120 or 220, 240V—15% to +10% to full specification relative to taps, 45 to 65Hz, or optionally.
- (b) 18 to 32V DC.

Power consumption

- (a) AC, 60VA approximately.
- (b) DC, 40W approximately.

Environmental conditions

- (a) The equipment is designed to operate under the following climatic conditions:
 - Operating temperature -10°C to +55°C.
 - Storage temperature -40°C to +70°C.
 - Relative humidity 95% at +40°C.
- (b) The equipment is suitable for transportable operation.
- (c) The equipment is suitable for air transportation in unpressurized conditions and for operation at altitudes of 3500 metres above sea level.

Dimensions

Height 133 mm (5.25 in)
Width 483 mm (19 in)
Depth 458 mm (18 in)

Weight

14 kg (31 lb)

Accessories

AA 660/A Headset, 600 ohms, with ventilated ear cushions, lead and plug.
Headsets are also available with standard ear cushions and anti-perspiration covers.

Note

All accessories and optional facilities to be specified at time of order.

Racal reserve the right to vary in detail from the description and specification in this publication.

RACAL

Racal Communications Limited

Bracknell Berkshire RG12 1RG England
Telephone: Bracknell 3244 Cables: Racal Bracknell Telex: 848166
Printed in England